cinefex

number 63
$7.50
Canada – $10.75

FOREVER AND A KNIGHT

article by
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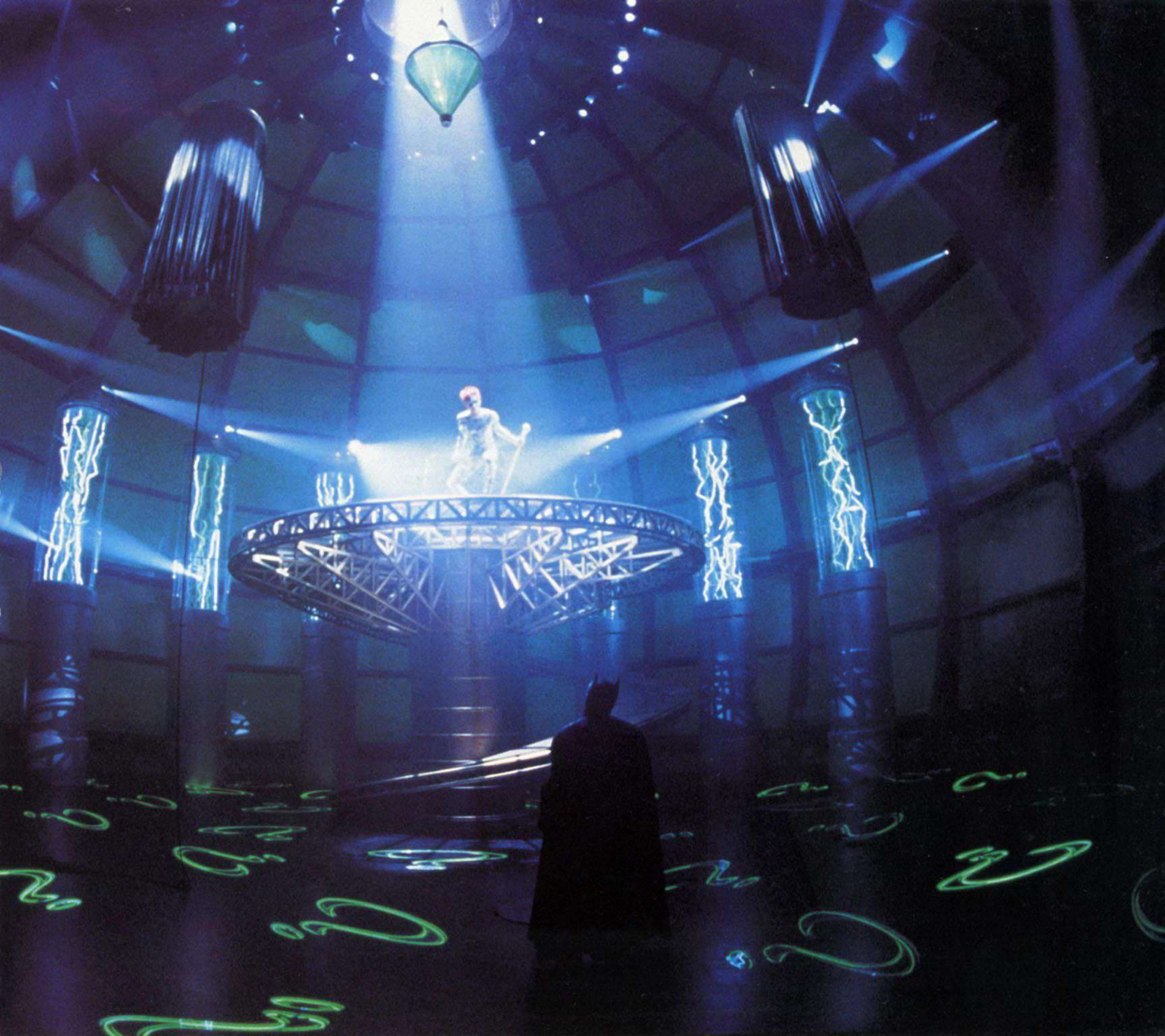
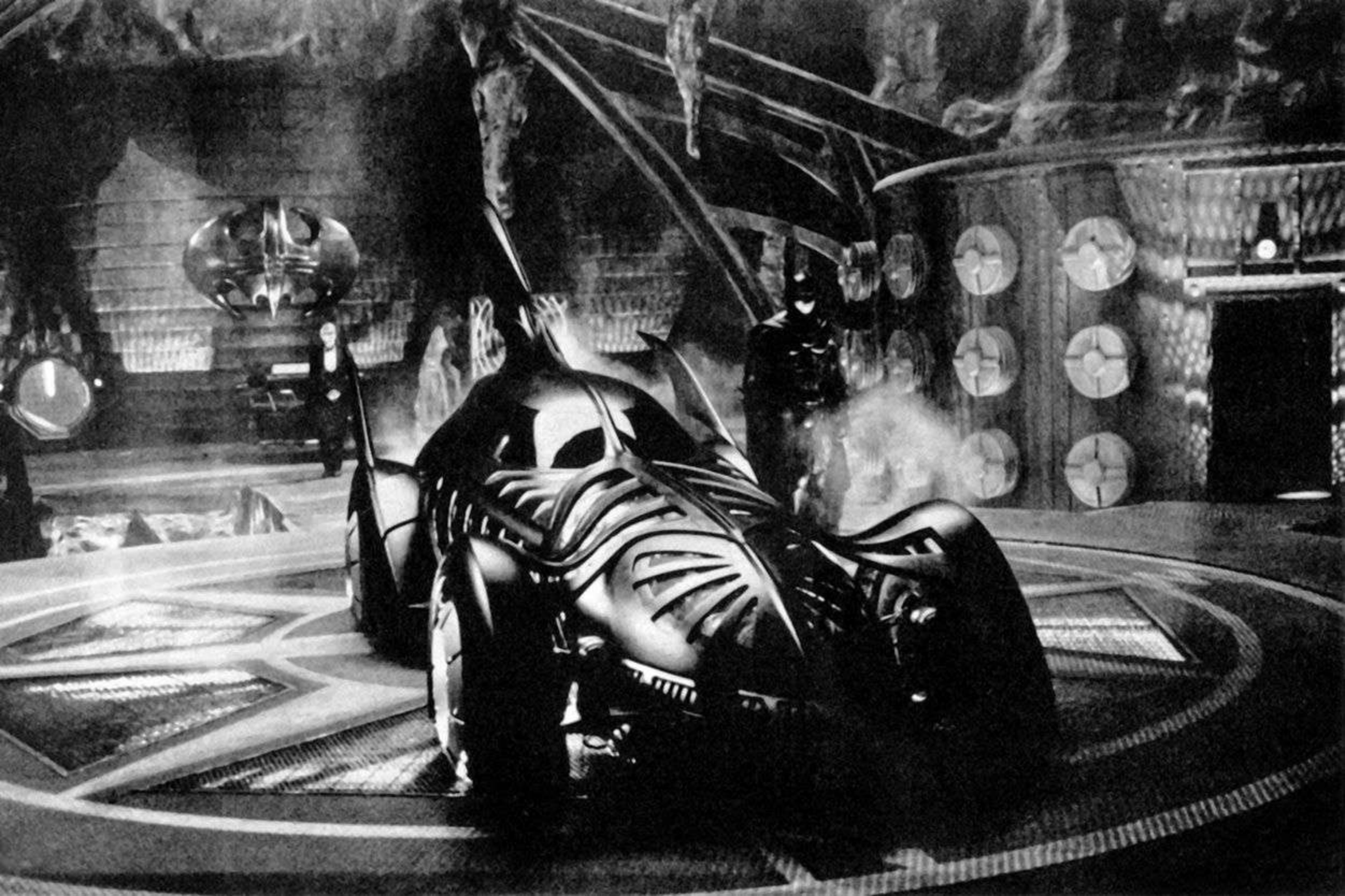




With its brooding Batman, psychotic Joker and gothic Gotham City, *Batman*—director Tim Burton's phenomenally successful 1989 film—was a revelation, particularly for critics and moviegoers expecting a big-screen evocation of the campy sixties *Batman* TV show. *Batman Returns*, Burton's 1992 follow-up, was darker still, with Gotham Plaza rendered fascistic and dehumanizing, the Penguin portrayed as a sewer-dwelling mutant plotting to murder children, and Catwoman a leather-clad, whip-cracking wildcat ready to rumble for the anarchistic kick of it.

For Tim Burton, attracted to offbeat characters and a fan of the stark, dark style of German Expressionism, *Batman* had been a grand canvas. But although he had built the comic book concept into a franchise film property for Warner Brothers, ringing up more than $400 million in domestic boxoffice returns, there was some grumbling, after the sequel's release, from parents unhappy about the unseemliness of infanticide and McDonald's Happy Meal promotional tie-ins. Rumors were also rife that Burton had tired of the series.

Batman Forever, the studio's current big-ticket production, would see wholesale revisions in the Batman saga. Although Burton would still keep his hand in the project by serving as producer, together with Peter MacGregor-Scott, the directorial reins would be turned over to mainstream moviemaker Joel Schumacher. "I was born in 1939, the same year Batman was created," Schumacher commented. "I've always loved comic books—they're like storyboards for films—and I've always been a Batman fan. So when Warners approached me to do the film, the adult in me might have pondered it, but the child in me said 'yes' immediately."

The transfer of directorial responsibility from Burton to Schumacher was not the only major change the new film would bring. Actor Val Kilmer would replace Michael Keaton as the Dark Knight, Robin would finally be introduced into the series, and Gotham City would be redesigned and lit up with splashes of comic book color. Both the dark and cartoony forces of the mythos would be retained in the film's villains—Two-Face, the once crusading district attorney Harvey Dent, whose mind has become unhinged by the facial disfigurement caused by a splash of acid; and Edward Nygma, aka the Riddler, a mastermind given to posing puzzles that hold clues to his forthcoming criminal escapades.

In addition to an ambitious slate of traditional miniature effects, the production would also boast an abundance of computer generated illusions. The computer graphics and image processing capabilities currently revolutionizing the film business had been but a glimmer in the visual effects landscape when *Batman* was first released. Six short years later, the filmmakers behind *Batman Forever* would be creating computer generated Gotham cityscapes and even a computer generated Batman. It was a brave new world, and one with which Joel Schumacher was not entirely familiar. "I was vaguely aware of the tools," Schumacher admitted, "but I had to do some read-

ing up on it. What I discovered is that you can do anything with this technology now." Helping Schumacher chart his course was visual effects supervisor John Dykstra. Dykstra had gravitated to the production not long after his groundbreaking Apogee effects company was dissolved in January 1993. The release of *Batman Forever* would mark the twentieth anniversary of his commencement on *Star Wars*, the film whose landmark effects he supervised and for which he was honored with an Academy Award. For one whose professional experience had revolved around motion control camera systems, optical printers and the world of photochemical and physical materials, the age of virtual cameras, image processing and computer generated characters meant new artistic freedoms. Advanced digital tools now at his disposal would allow Dykstra – and an army of effects practitioners – to bring wholly to life Schumacher's vision of a film fusing both live-action reality and the fantastic, graphic sensibility of the Batman comics.

"On this film, there's an interesting mix of realism and the forced perspectives and unusual colors of the comic book," Dykstra commented. "It's less theatrically staged than the first two films, more stylized and surrealistic. We were able to open up Batman's world because of the images we can now bring to the screen. All of the storytelling genres have been opened up, in fact; but the technological ability to produce those kinds of images feeds upon itself, so these types of pictures aim to top themselves in scale and complexity. As a consequence, the scope is so great that the collaboration needed to produce these images has never been a more important factor in a film's success than it is now."

On *Batman Forever,* the art of collaboration was particularly vital, given that the studio had allotted a mere three months for postproduction, a seemingly impossible schedule for a film with some 250 effects shots. "One of the biggest challenges the production faced was the postproduction schedule," Dykstra affirmed. "Basically, first unit and postproduction were occurring at the same time. I incorporated into my thinking how to complete an accelerated back-end, but I also tried not to let the time period we had limit the envelope we decided to draw for ourselves in making the picture. We set out to do visual effects as they integrated into the story."

More than eleven effects houses would be in on the action, with many shots requiring the efforts of three or more vendors with specific expertise: Warner Brothers Imaging Technology, gearing up to create a digital backlot for its parent company, would create some of the most complex CG cityscapes and digital matte paintings ever attempted in a feature; the character animation specialists at Pacific Data Images would have the task of creating a computer generated Batman for mega-stunt scenes; MetroLight Studios, well versed in digitally producing photorealistic representations of natural phenomena, would furnish a new-look bat signal; Rhythm & Hues would create part of the Riddler's lair via computer graphics, and composite in bluescreen photography of Batman, Robin and love interest Chase Meridian; Illusion Arts would bring both traditional and digital tools to bear on key establishing scenes; the editorial suite at Composite Image Systems would be utilized to assemble some ninety-nine complex shots; Rick Baker's Cinovation Studio would contribute animatronic bats and the Two-Face makeup; and VIFX would take to their own water tank and an Olympic-size swimming pool to realize underwater explosions and a pivotal batwing transformation.

To coordinate the massive project, specific supervisory duties were assigned to team members under Dykstra's direction, with Boyd Shermis and Eric Durst dividing the miniature photography between them, David Stump serving as effects director of photography with the first unit, and Andrew Adamson taking charge of the digital workload. "With all of these vendors," Adamson commented, "the challenge was making sure everything had continuity. In a way, the short deadline was a good thing in that it forced us to make quicker decisions, which meant going with John Dykstra's instincts throughout the movie. John pushed some things in digital that people haven't tried to do before – or have tried unsuccessfully – such as creating a number of CG environments and doing a CG stuntman for some of Batman's action scenes. The short deadline resulted in a very aggressive approach to the movie."

One of the ways in which Dykstra sought to insure continuity – essential with so many companies doing digital effects and compositing – was to engage a single source to provide high-resolution film scanning and recording services for all of the companies involved. After researching available options, he selected EFILM – short for Electron Filmworks – a digital film laboratory founded in 1993. "The idea," Dykstra explained, "was to run the primary scanning and recording through one facility so that, in a single step, I could eliminate a whole raft of variables, including color, gamma curves, black levels and sharpness, and achieve a consistent look across as many effects houses as I need to work with." Although circumstances prevented one-hundred-percent achievement of this objective, EFILM did provide most of the scanning and recording for the production – a total of some 97,000 frames of film.

From the start, Schumacher and his creative team were determined to not merely reflect Tim Burton's unique vision, but to take the series into new and exciting creative areas. "My research included going to DC Comics and poring over hundreds of Batman comics from 1939 to now," Schumacher recalled. "When you immerse yourself in hundreds of comics, you come away with an enormous respect for the artists, particularly for the way they used color. For this film, I wanted to make the comic book. I didn't want to go so far as to use bordered panels, but I did want to frame the movement in such a way that I could create a sense of the design and impact of a comic book panel. Because of computer technologies, we were able to enhance all the buildings with heightened colors to create the colorful look of a comic book."

Tasked with bringing the comic book aesthetic to *Batman*

In Batman Forever *– Warner Brothers' third installment in its comic book film franchise – the directorial reins were transferred from Tim Burton to Joel Schumacher, who brought a lighter touch to the proceedings. Significant changes included the casting of Val Kilmer – replacing Michael Keaton as the mysterious Caped Crusader – and the introduction of Robin to the series. Also introduced were a new batmobile and a redesigned batcave, erected in a giant Long Beach dome hangar that formerly housed the* Spruce Goose. */ Adding campy villainy to the production were Jim Carrey as the diabolical Riddler, a techno-nerd turned criminal mastermind, whose chief pleasure is derived from taunting victims with obscure riddles; and Tommy Lee Jones as Two-Face, former district attorney turned deranged crook, whose facial features are hideously acid-scarred on one side while perfectly normal on the other. Appliance makeup for the character was designed by Rick Baker.*

Forever was production designer Barbara Ling, who had previously collaborated with Schumacher on *Falling Down*. One of her major assignments was to recreate and redefine Batman's Gotham turf. The centerpieces of the first two films had been, respectively, a quarter-of-a-mile backlot Gotham City Square set at Pinewood Studios in England, and a Gotham Plaza set that filled the biggest stage at Warner Brothers. The Gotham of *Batman Forever* would not be as theatrically based, but would be created with motion control miniatures, computer generated cityscapes, matte painted vistas and some location work in New York and Los Angeles.

Preproduction for Ling included a four-day trip to Japan to look at cutting-edge modern architecture, and starkly contrasting visits to abandoned and boarded-up New York subway sites full of art deco and gothic elements. Also providing inspirations were the classic Machine Age designs of architect Raymond Loewy and the visionary drawings of a monumental, futuristic New York by architect Hugh Ferriss. But the ultimate creative resource was the Batman comic book tales which had developed a more complex and cosmopolitan Gotham than had been explored in either the TV show or the earlier films. That mythic Gotham was not merely a *noir* landscape of full moons, long shadows and lurking denizens of the underworld, but a cosmopolitan environment of high-rise buildings, fashionable shopping districts, skid rows, industrial centers, waterfronts and an exotic Chinatown. "My approach was to open up Gotham so you could get the sense of diversity you would find in a real city, with a mix of cultures and buildings that were both old and futuristic-looking," Ling explained. "I didn't want Gotham to be tagged to a specific time period. One of the great aspects of the Batman comics is that they're timeless."

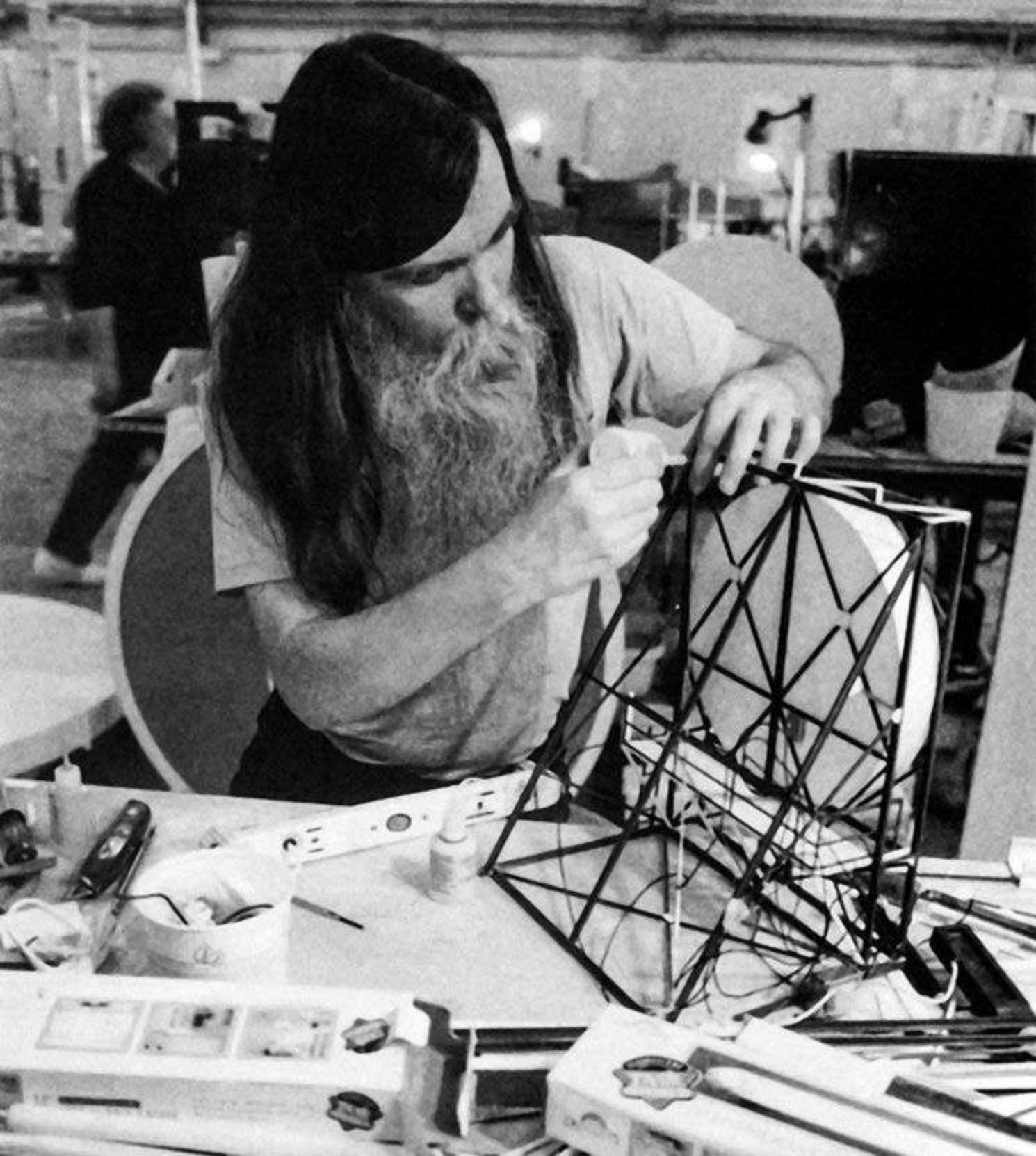
The Gotham of the comics was also a surreal landscape of giant, rooftop advertising props and monumental statuary. The concept of massive sculpted figures integrated into the urban landscape would be one of the major *Batman Forever* design motifs. Although production designer Bo Welch had embellished *Batman Returns* with a smattering of such sculpture—in particular the muscular male figures ringing Gotham Plaza—the *Batman Forever* cityscapes would incorporate sculptures nearly as large as the buildings themselves. "When Barbara and I designed Gotham," Schumacher stated, "what was most important to me was that there be huge statues throughout the city. In some of my other films, I had had this sculptured look, such as the medical school in *Flatliners* in which the building's architecture is full of faces and forms that seem to be holding everything up. It's amazing the emotions we invest in the human form. I thought that these statues would add a lot of personality to the city."

The final design for Gotham featured a vaulting, vertical motif—a trend in fantastic cities from *Metropolis* to *Blade Runner*—with the notion that retrofit architecture built atop older skyscrapers had extended the height of the city skyline. "The idea, developed from early conversations I had with Barbara, was that as the city grew upwards, existing buildings were retrofit and transformed into a newer layer of Gotham," explained James Hegedus, visual effects art director in charge of bringing the designs into the realm of computer graphics and miniature photography. "The city starts off with an older, deco feel, but the original forty- to fifty-story buildings have been retrofit into super-structures that are now eighty to ninety stories tall. It was also our intention that Gotham would possess many different areas—not only laterally across town, but vertically as well—so we incorporated layers of new bridges and super-roadways into these levels to accommodate traffic at the upper reaches."

Two major fly-through sequences would demonstrate the expansiveness of the city: a nighttime bank heist and helicopter flight achieved with models and miniatures, and a daylight passage through a completely synthetic Gotham. The former sequence, which opens the movie, was filmed on miniature sets erected at a former Hughes Aircraft hangar in Marina del Rey where army helicopters had once been produced. The facility, in sight of the double-size hangar in which the *Spruce Goose* had been built, was divided up into moveable shooting stages and had an adjoining airstrip for staging miniature pyrotechnics. The principal Gotham cityscape consisted of fourteen twenty-fourth-scale art deco skyscrapers built originally by Stetson Visual Services for *The Hudsucker Proxy*. The miniatures had an unusual pedigree, having gone from Warner Brothers after the completion of *Hudsucker* to Universal Studios for *The Shadow* and then back to Warners for the third Batman film. "When we started, the *Hudsucker* buildings were really decrepit," noted model shop supervisor Michael Joyce. "We had a ten-person crew spend about a month getting the buildings up to snuff, casting new molds for parts to replace windows, fire escapes or other missing parts."

Once restored, the miniatures—many approaching fifteen feet tall—were detailed with pipes and buttresses and monumental sculptures to accommodate the retrofit design scheme of *Batman Forever*. Joyce and his crew also built a number of buildings from scratch, including one under construction and two scale versions of the Second Bank of Gotham which would be the setting for the heist and the ensuing battle between Two-Face and Batman. "We built about seven stories of the Gotham Bank in sixth-scale, which gave us a model about twenty feet tall," Joyce explained. "We also built a twenty-fourth-scale view of the full bank which, at twenty-eight feet, was our tallest building. It took six weeks for Greg Stuhl and Dave Emery to build the twenty-fourth-scale Gotham Bank as a three-sided plexiglass miniature, with two ten-foot sections and an eight-foot section all bolted together. Our big bank had a lot of retrofits on the top half of the building, with flying buttresses, a clock, statues, pipes, green smoke-glass windows and marble fascia. There were a lot of details, such as seven hundred window sections for the sixth-scale building wall, all made separately of styrene. They were painted, glued on and

Expansive miniature sets, filmed motion control under the supervision of Boyd Shermis and Eric Durst, were combined with computer generated imagery, matte paintings, full-scale set pieces and location footage to create a complex, cosmopolitan Gotham City. Modelmakers working under supervisor Michael Joyce constructed several large set pieces from scratch, as well as pressing into service a number of miniature skyscrapers originally built by Stetson Visual Services for The Hudsucker Proxy. *The existing miniatures required extensive restoration and detailing to accommodate the retrofit design motif of the film. / A motion control camera moves through the Gotham City set, smoked to create aerial density and lit with splashes of comic book color. / A nocturnal beauty shot reveals a sampling of the ubiquitous giant statuary incorporated into the cityscape.*



scribed with a straight-edge scribing tool so we could get caulk in there to look like grout. Scott Valdes, who headed up the paint department, hand-painted surfaces on both of the banks in scale to look like marble."

The Hughes hangar work would include a complex shot combining New York location footage of a roaring batmobile with a camera tilt-up transitioning to a crowded miniatures skyline and a MetroLight bat signal above. The shot required three layers of bluescreen photography of the miniatures. Eric Durst—using motion control equipment and crews provided by The Chandler Group—employed three Personal Animation Recorder units to assist in lining up all of his complex composite shots. "What we did was different from digital previsualization because we were not creating 3-D CG images," explained motion control camera operator Mark Hardin. "Rather, we were utilizing a video tap from the cameras, with each frame of information corresponding to a frame position in the motion control unit so we could play the shot back frame by frame and lay down test move after test move. For the bank heist sequence, we could take the motion control move of the flight through the city, play it back, and lay the helicopter move to correspond frame by frame with the flight path."

"The PAR system was a lifesaver because there were many things to match and check out," Durst affirmed. "We matched the live-action with an animatic we did in CGI, and then we matched our motion control miniature photography to the live-action—so there were two levels of photography on this shot for the rise through the city. All of the different elements had to fit perfectly, because if the buildings weren't lined up right they would start to separate. PAR came out about two and a half years ago, but its capabilities for motion control have only been recently realized. Previously we would have to shoot tests on high-con, black-and-white film, then sandwich them on the Moviola. Now we can marry elements more interactively; so, basically, we can do four shots in the length of time it once took to do two. It's still motion control model photography; but what's new is that we can marry so many more elements within the shot."

In the nocturnal bank heist sequence, Two-Face blows a hole in the side of Gotham Bank while a street celebration is going on in the multicultural Pan-Asia district below. He then hoists out a vault using a chain attached to his getaway helicopter. A vigilant Batman releases the vault, causing it to swing back into the bank through the blasted wall. Unfortunately, the Dark Knight is left hanging from the end of the severed chain as a gleeful Two-Face orders his pilot to fly through the skyscraper canyons at full speed. During the precarious passage, Batman is nearly snagged on the horns and wings of a gigantic devil statue, smashes through a billboard, and ends on a collision course with the Lady Gotham statue gracing Gotham harbor.

The sequence begins with the most elaborate location work in the film, a nighttime enactment of a Pan-Asia celebration created on busy Figueroa Street in Los Angeles. The six-lane thoroughfare was closed to two lanes and dressed with twenty-five-foot-tall storefronts positioned across from an actual bank building. On an adjacent empty lot, the production built eighty feet of skeletal girders to represent a building under construction. Matte paintings by Illusion Arts helped conjure up some of the magic of Pan-Asia Town and extend the location set with surrounding buildings. "The idea was that the Pan-Asia storefronts were built into these super-structures in the manner of the *Blade Runner* buildings," said Illusion Arts co-founder Syd Dutton. "We scanned in the live-action footage, and Mike Wassel added a digital painting in Photoshop of buildings behind the storefronts along this gigantic corridor. Barbara Ling loved the look of gigantic buildings connected by layers of elevated roads. We had gags throughout, with Fumi Mashimo animating the neon for a foreground Chinese dragon sign that Mike painted, as well as dragging digital lights across the bridges to represent street traffic."

The ensuing helicopter flight through Gotham recalled the Boss Film Studios shot in *Batman Returns* in which Catwoman dangles from the end of a flying Penguin umbrella. The Boss shot was created with an optical move on a bluescreen stuntwoman composited into a multiplane matte painting and miniature Gotham environment. In *Batman Forever*, the technological options were such that a synthetic character would take the risks of a flight deep into the canyons of a miniature city. "Originally we thought of doing the helicopter sequence with a CGI city," explained visual effects production supervisor Jo Ann Knox, "but once we saw how labor intensive and time consuming that would be, it seemed more beneficial to do it with miniatures."

The opening of the scene—which incorporated live-action elements of an abducted bank guard, as well as Batman freeing the vault from Two-Face's helicopter—required special smoke treatment of the background miniature environment to match the atmospheric effects Joel Schumacher had used throughout main-unit photography. To that end, Andrew Adamson devised a multiplane image processing effect that was utilized in the twenty-seven shots that start the sequence. "Joel shot a lot of smoke throughout the live-action," Adamson noted, "and when you have lights in a smoky environment, it creates the look of saturated wafts of colored smoke—which was a particular challenge for miniatures since you can't smoke up bluescreen, and motion control isn't real time. So we ended up shooting different smoke elements on stage and tracking the smoke to match camera motions and angles. Then—mostly at CIS—we would take our backgrounds and digitally extract the window highlights, blooming them through soft-edged mattes of the smoke elements, then put a smoke layer over that and another smoke layer for the foreground. It made the windows look as if they were diffusing through the smoke. We had at least five to six layers in that sequence."

One of the key elements in the scene was the helicopter model built by John Merritt and Bill Shourt of Private Gardens.

A harbor statue of Lady Gotham was sculpted, photographed by itself and matted into the cityscape as needed. Modelmaker Pete Gerard installs a rotating searchlight in the statue's torch. / Modelmaker Kento Gebo wires miniature fluorescent lights for the translight surface of a Gotham City sign, one of many incorporated into the miniature environment. / Giant statues carved out of foam were among the surreal elements embellishing the urban landscape of the miniature Gotham set. A sculpting team headed by Yarek Alfer created most of the massive figures.

To facilitate filming, Durst and his crew mounted the eighth-scale model on its side, attached to a motion control rig capable of all axes of movement. Using a process developed at Apogee, special colored phosphorescent paints were applied to the model—blue for the propeller and bright red for the fuselage—to better isolate the elements during the digital compositing stage. "The helicopter was so black and shiny that whether we filmed with a blue- or greenscreen behind it, the color would reflect on the model and we wouldn't be able to matte it," Durst explained. "But with this phosphor process, we could create a matte without any spill problems. Because the paint is a self-illuminating phosphor shot against black, the helicopter, in essence, is its own bluescreen—separating itself so you can pull mattes off the red or blue. Also, because we were not limited by having to have a screen behind the model, we could perform more elaborate camera moves."

Pacific Data Images motion-tracked to the chopper both a synthetic chain and a computer generated Batman figure. A digital model, together with motion data collected from shots of a performer swinging from a rope, was inputted into the company's proprietary system which allowed for manipulation and refinement of the database. The motion capture served as a rough guideline, with most of the articulation on the character provided by the digital animators.

Lighting was key to matching the computer generated figure to bluescreen shots of Batman dangling from the chain. "My goal was to integrate Batman into the scene and to make the integration work with adjacent shots," explained PDI lighting supervisor Jean Cunningham. "We positioned lights in our CG world in the manner of a DP setting up lights on stage. We controlled the quality and color of the lights and of the surface attributes of the CG Batman to make it look like a real guy in a suit. The helicopter sequence was difficult because Batman is small in frame and the environment is huge. He had to be visible, but not unrealistically bright. We had the CG Batman pass through colored lights as he swung through Gotham."

The monumental statuary of the city also figured into the superhero's wild ride. "One of our sculpted figures is a giant devil statue whose form suggested itself for a shot in the helicopter sequence where Batman is almost snagged on its horns and wings," James Hegedus remarked. "The shot was a real challenge for miniatures. When you see a sculpture on the side of a building that's two or three times bigger than the Statue of Liberty, that's not a scale you're used to, so you can have trouble believing it. Even though we had planned out the sequence with digital animatics, with miniatures there was always going to be tweaking and rearranging. Almost daily we were recomposing shots."

The illusion of the helicopter flying through a billboard was accomplished with pyro charges rigged to blow up a miniature sign just seconds before a rod pushed the aircraft through. "We shot the pyro work at 120 to 200 frames per second," Durst explained. "Then PDI did some motion blur on the rotors so they would appear to be traveling at high speed." The billboard—a colorful eye-shaped sign for Ocu-Wash eye wash—was constructed by Mike Joyce's crew out of eighth-inch tempered glass. The billboard was comprised of thirty-five pieces which, when fastened atop one of the *Hudsucker* models, rose to a height of seventeen feet. "We made a linear track and positioned the eighth-scale helicopter on a rod with a tail mount and a bungee cord to push it through," Joyce explained. "There were trips on the track that set off the pyro as the helicopter moved down it." To footage of the chopper crashing through the sign, PDI added their computer generated chain and hanging Batman. They also incorporated digital neon into the sign and added fire and smoke to obscure the visible two-inch rod mount that pushed the model through.

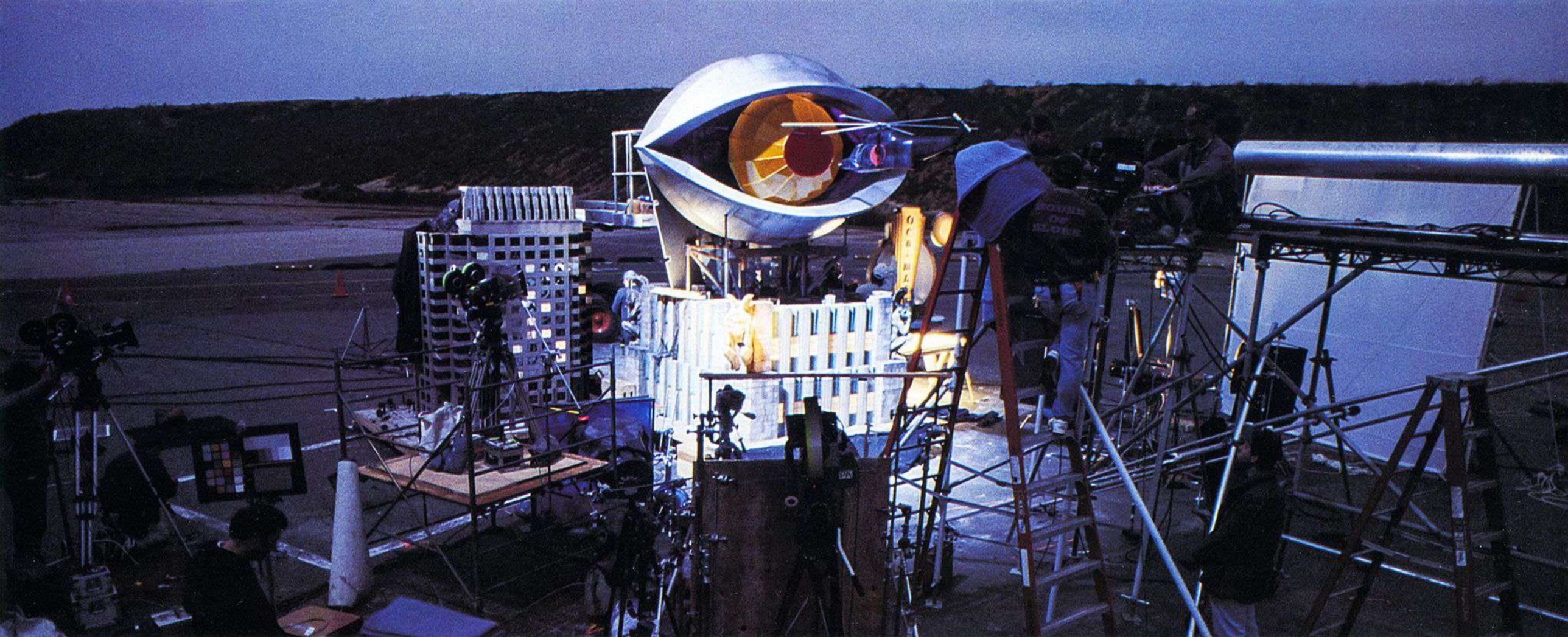
For the climax of the sequence, Batman manages to pull himself into the helicopter, only to have Two-Face lock the controls and parachute to safety as the aircraft heads toward the harbor on a collision course with Lady Gotham. The action would cut between miniature motion control and live-action special effects work. "At Warner Brothers," Hegedus explained, "the production had a full-scale helicopter stationary on a gimbal with a Lady Gotham model pushed on speed rails toward it. Then we would go to our miniature helicopter being pushed into the statue until it makes contact and blows up. Working drawings for Lady Gotham, based on designs Barbara had created in the art department, were delivered to Mike Joyce who built it in the same scale as the helicopter."

For the impact shot, Joyce discovered that the original Lady Gotham model was not quite big enough, so he engaged Yarik Alfer to sculpt another head that was twenty-five percent larger. From that sculpture, three fiberglass pyro heads were constructed, with a breakaway section in the left cheek where the rotors were to hit. As with the billboard effect, the helicopter was pushed in on a two-inch rod mount, the blades spinning at a thousand revolutions per minute. Unexpectedly, the impact of the blades cutting into the fiberglass head caused the statue to buckle and warp, betraying the illusion. A digital fix was assigned to PDI. "We had to stabilize the image by digitally extracting the shakes," noted facility effects supervisor Richard Chuang. "Where the blade cut into the statue's eye, we replaced the shaking area with a clean plate of the stable head, then recomposited the debris and fire of impact."

The aerial bank heist is followed by another fly-through over Gotham and into Wayne Enterprises. Whereas Gotham in the first sequence was achieved through a combination of models, matte paintings, full-scale set pieces and location sites, this fly-through was achieved using a digital cityscape. "The only way we could do the fly-through approach to the Wayne Enterprises headquarters was CG," Schumacher explained. "The shot was supposed to look like a helicopter shot, but since it would have been too dangerous to do practically, we had to create this entire landscape."

The aerial journey would cover an estimated half mile of air-

Having foiled a bank heist staged by Two-Face primarily to entrap him, Batman finds himself clinging perilously to a chain attached to a careening helicopter. As darkness approaches, effects crew members prepare for a night shot in which the helicopter—a model tail-mounted on a rod extending from a linear track—smashes through an eye-shaped billboard. / The billboard—a miniature made from tempered glass rigged with pyrotechnic charges—shatters moments before impact. / In postproduction, Pacific Data Images replaced rotors on the model helicopter with digital alternates that produced superior motion blur. PDI also incorporated digital neon into the sign and added a computer generated Batman dangling from the chopper and motion-tracked to the shot.



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space, passing over a chasm of Gotham skyscrapers, wiping behind a building, opening onto a panorama with dozens of skyscrapers lit by the setting sun, flying over Gotham River and toward Wayne Enterprises, with the corporate headquarters rising like an art deco jewel complete with monolithic statues and cascading waterfalls from a gigantic power plant built into the structure.

The task of producing the computer generated city shots—which included not only the fly-through but backgrounds for a falling digital Dark Knight—went to Warner Brothers Imaging Technology, a new division for the studio that started up in 1994. With John Scheele as senior visual effects supervisor, the company began work on the digital Gotham fly-through. The assignment made sense in a strategic context, since Warner Brothers is part of the massive Time Warner media conglomerate that also encompasses DC Comics and its whole pantheon of superheroes, including Batman, Superman and Wonder Woman. Creation of a computer generated city for *Batman Forever* would therefore represent the beginnings of a digital backlot that could be applied to the differing needs of any future comic book movie. "Part of the reason we went after the city work on this film," noted WBIT visual effects production manager Amy Harrington, "is that one of our goals is to be an asset base for Warner Brothers. In building the city, we have assembled a huge library of high-rez buildings, textures and architectural details that can be part of Gotham or Metropolis—or even be made to look like Cleveland."

A green light was given to do the scene digitally after initial tests showed that WBIT's virtual cameras could get very close to sunlit building surfaces and still retain credible quality. Testing at the company's Sherman Oaks facility also included a previsualization phase during which John Dykstra roughed out a computer graphics layout as well as the basic flight path for both the CG fly-through and the Two-Face heist sequence. "We used to plan out camera moves with miniatures and a video camera," Dykstra noted. "Now computers animatics can bring storyboard drawings into 3-D form. Our animatics became the template we used to photograph the miniatures and, in some cases, generate the CGI buildings. Because real-time reproduction is not a computer forte, there are a limited number of details you can put into any given scene; but once you've got a mathematical model of a building, you can use it as a CG building, encode it into an animatic, or use it as a previsualization tool for figuring out camera angles."

To construct virtual Gotham, WBIT brought on a team of architects, with the two principals, Lance Hammer and Curtis Auspuerger, experienced not only in urban design but in using Alias and other modeling and rendering systems. "In building our Gotham City," Hammer said, "there was the question of how to create all the geometry and render all the buildings with the available tools. Because of all the pieces of geometry and the texture maps, the rendering time was just phenomenal. It really pushed the limits." Dealing with the massive amount of data as a single file was impossible, so the sequence was divided into twenty files that would be composited and rendered at the end. "Wherever possible, we rendered groups of buildings relative to their distance from camera," explained John Scheele, "with the levels closest to camera rendered with full 3-D smoke and diffusion and distant buildings rendered with flatter, more gradated veils of smoke elements added separately. We felt it was necessary to render foreground buildings with 3-D atmosphere to reveal realistic depth. It was a shortcut to render the flat smoke separately as opposed to rendering it as 3-D into the scene, but our tests showed it would have the correct look and perspective."

Four solid months were devoted to actual construction and rendering of the virtual city, during which time photographic texture maps were laid over the geometric shapes of the digital Gotham. "Using sophisticated texture maps with simple polygons was a work-around that solved a lot of problems for us," stated Hammer. "All of the texture maps were extremely high-resolution and based on real photography applied as a kind of sophisticated decal. With Photoshop, we would then add the bump maps and staining details. The texture maps, which had the color properties of real metal, had to look real because we got to within inches of them."

To capture building details for the texture maps, members of the WBIT crew scoured the streets of Los Angeles with still cameras. John Scheele, Amy Harrington and Stephen Brand also photographed New York cityscapes, including the actual buildings and street sets lit by main-unit director of photography Stephen Goldblatt. "We waited until the lighting was all set on the location," recalled Brand. "Then we would step in between takes and shoot the building surfaces. We also shot the same details later under full flat lighting to be used more generically." Such images would prove extremely valuable in detailing the computer generated cityscape. "Computer images tend to be clear," Harrington noted, "but real buildings have years of accumulated stain and dirt and gritty textures. So, when John Scheele and I were on location, we photographed these beautiful stains and mapped them onto other textures to put onto our digital buildings."

To capture the precise look of the giant statuary that distinguishes Gotham, prototype sculptures were sent out to Viewpoint DataLabs for careful digitizing. "We made an effort to use other scanning techniques," stated Scheele, "but Viewpoint really has this method down. The two giant Indians guarding the spillway near Wayne Enterprises were encoded in that manner, as was the huge statue of Atlas holding up an astrolabe. There were also many statues that were treated by our artists directly in Alias, and several done by using the raised relief techniques available in the Macs."

After an introductory scene inside Wayne Enterprises, the bat signal alerts the Caped Crusader that his services are needed. Inside his posh office, Bruce Wayne makes a quick exit through a trapdoor in the floor which deposits him into a luge

Two-Face sets the helicopter, with Batman aboard, on a collision course with Lady Gotham. A large-scale model of the statue is readied for a shot of the fiery crash. / Effects crew members add last-minute detailing to one of several fiberglass heads built to accommodate multiple takes. Breakaway sections in the cheek were rigged to shatter when struck by the helicopter's spinning rotors. Upon filming, however, the crew discovered that the blades' cutting into the head caused the statue to buckle and warp, requiring a digital fix by PDI. / As with the billboard effect, the miniature helicopter is tail-mounted on a rod prior to being pushed into the statue to simulate the collision.

tunnel where he is propelled – at hundreds of miles an hour – towards his subterranean batcave. The luge and tunnel were all-digital effects produced by Pacific Data Images. "Doing the luge sequence in CG gave us the flexibility to put the camera anywhere and do camera moves that would have been physically impossible," Adamson asserted. "In CG, you can move faster through an environment because you can keep extending your set – something you can't do with miniatures."

With their digital luge rocketing through miles of virtual tunnel, PDI discovered that established rendering procedures did not apply. "In normal rendering, you describe geometry, objects, motion, surface textures, lights and so forth," said company technical director Wendy Rogers, "but the luge was moving so quickly, and covering so much ground, that there was too much data. For the luge to travel at such a high speed, we had to render everything – luge, different sections of tunnel, lights – as separate passes. We applied surface textures, scanning in different metallic looks and lighting schemes in the various tunnel sections. The luge also had its own light source, an ethereal blue glow underneath the vehicle."

Because of the high speeds that were specified, it was also necessary to devise a new technique for creating motion blur. "In normal CG motion blurring, the moving object is tracked frame by frame," Richard Chuang explained, "but our luge was moving so fast that it was never in the same place in frame; so it was difficult for the computer to read it. In real life, you could photograph a moving object and you would have motion blur; but in CG, you have to go extra steps to approximate a real camera. We had to track the luge each 1/48th of a second that the virtual camera shutter was open per frame. That way we could get all the subtle motion blur, as well as add shake to the moving virtual camera."

Once the luge has safely deposited Bruce Wayne into the batcave, the millionaire businessman assumes his Batman persona. The batcave had always been a key physical and psychological environment in the comics, but the first two movies had utilized only minimal batcave sets extended with matte paintings. In Schumacher's film, Batman's cavernous lair would be realized as a sprawling tri-level set – big enough to accommodate the batmobile's departures and arrivals – that also incorporated a lower lagoon housing a full-scale batboat.

Like many of the film's major sets, the batcave was erected at the former *Spruce Goose* hangar in Long Beach. One hundred ninety feet from floor to ceiling and some four hundred feet in diameter, the famed dome hangar allowed the batcave set to rise eighty feet high, with lighting grids in the darkened structure creating the illusion of its rising hundreds more feet in the air. The three levels, each connected with steps, included such upper-cave features as Alfred the Butler's crime lab, an armored vault, a weapons display, a wall of monitors electronically connecting Batman to the outside world, and, for the batmobile, a central, hydraulically-powered steel turntable, thirty feet in diameter, that could not only rotate but also raise and lower twenty-four feet. The middle section was a rugged cave, unadorned by the technological trappings of Batman's crime-fighting operation, while the lower level was taken up with the lagoon in which the batboat is moored.

The practical batcave set was expanded with models to fulfill specific aesthetic and plot requirements. For a scene of the batwing hanging, batlike, from a cave wall, Grant McCune Design built a twelfth-scale fiberglass batwing model – about two feet wide and three feet long – and an accompanying cave miniature twenty-five feet tall and twelve feet wide. Footage of the batwing hanging from the miniature cave wall was composited into a live-action wide shot panning up from the batboat past Batman and Alfred. A traditional Illusion Arts matte painting both extended the batcave environment and blended the two plates. "We try to integrate traditional matte painting and digital technologies," observed Syd Dutton. "For the shot in the lower batcave, it just seemed that all the elements would blend more easily with a traditional approach. Rob Stromberg and I created a three-by-five-foot glass painting with the live-action rear-projected in the lower left section and the model photography rear-projected in the upper right."

The inner batcave would also provide an atmospheric setting for a flashback – inspired by Frank Miller's graphic novel *The Dark Knight Returns* – in which a six-year-old Bruce Wayne, recently orphaned, discovers the vast cave beneath his family estate and is transfixed by the screeching bats which inhabit its darkness, planting the emotional seeds of his future alter ego. For the film reenactment, two animatronic bats – in differing scales – would be created by Rick Baker and his Cinovation Studio. A cable-operated version with a five-foot wingspan was built for distant shots of the bat, while another, much larger, radio-controlled version with an eighteen-foot wingspan was built to confront Val Kilmer in closeup.

The Cinovation bat team included Mike Elizalde, Eddie Yang, Matt Rose, Claire Manion and Jurgen Heimann, with mechanical design provided by Mark Setrakian. Mechanisms for the smaller bat were operated by a puppeteer working a joystick with two cables connected to a junction box from which tubes extended to support the puppet's weight and transfer both a torsional movement to flap the wings and a concurrent push-pull movement to extend the wings. "The junction box changed what was basically a pulley action into a linear motion," explained Setrakian. "I had to distill down the motion of the bat wing to two axes per wing, with two cables to extend and retract and two cables to flap forward and backward. The pivot points for the flapping were deep inside the body, so the entire body moved. There were silicon pectoral muscles, with mechanism support plates that got squeezed, and push rods inside the tubes that controlled the rod linkage of the wings. Once the design for the wings on the small bat was worked out, it was a simple matter to scale it up for the big bat, with motors and a linear actuator to extend and flap the wings."

Initially, Baker harbored concerns that the large bat's size

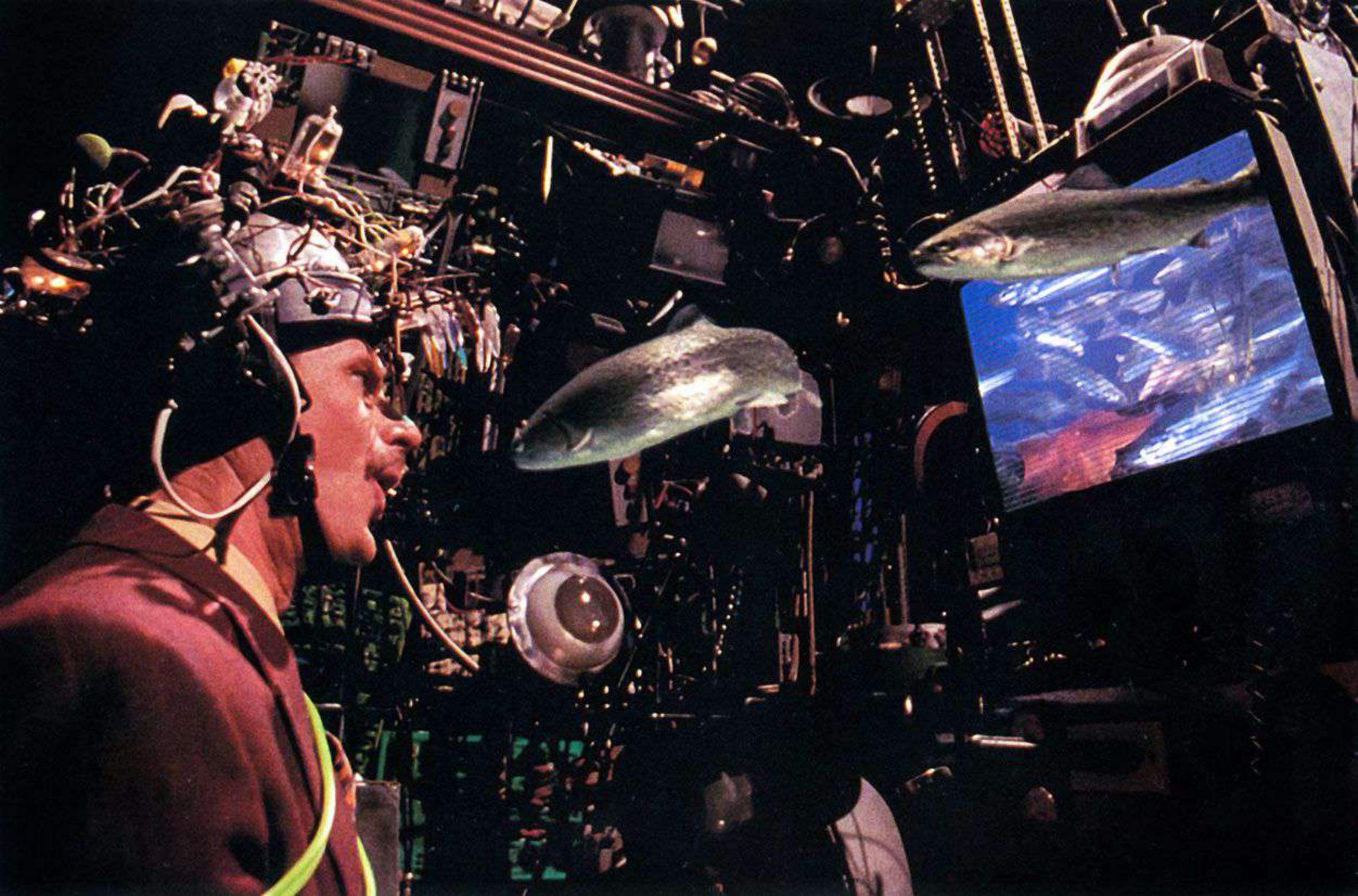
For an establishing fly-through over Gotham and into the headquarters of Wayne Enterprises, Warner Brothers Imaging Technology produced a wholly computer generated three-dimensional cityscape, complete with detailed skyscrapers and statuary. / Wayne Enterprises plant manager Fred Stickley (Ed Begley, Jr.) becomes an unwilling test subject for the Riddler's prototype invention – a television adapter that transforms video images into 3-D holograms while surreptitiously sapping brain waves. For a shot of three-dimensional fish emerging from a television screen, Composite Image Systems digitally extracted the fish from bluescreen tank photography and matted them into space. Color shifts and other surface treatments were added to link the fish with the video environment and simulate the signal beam breaking up.

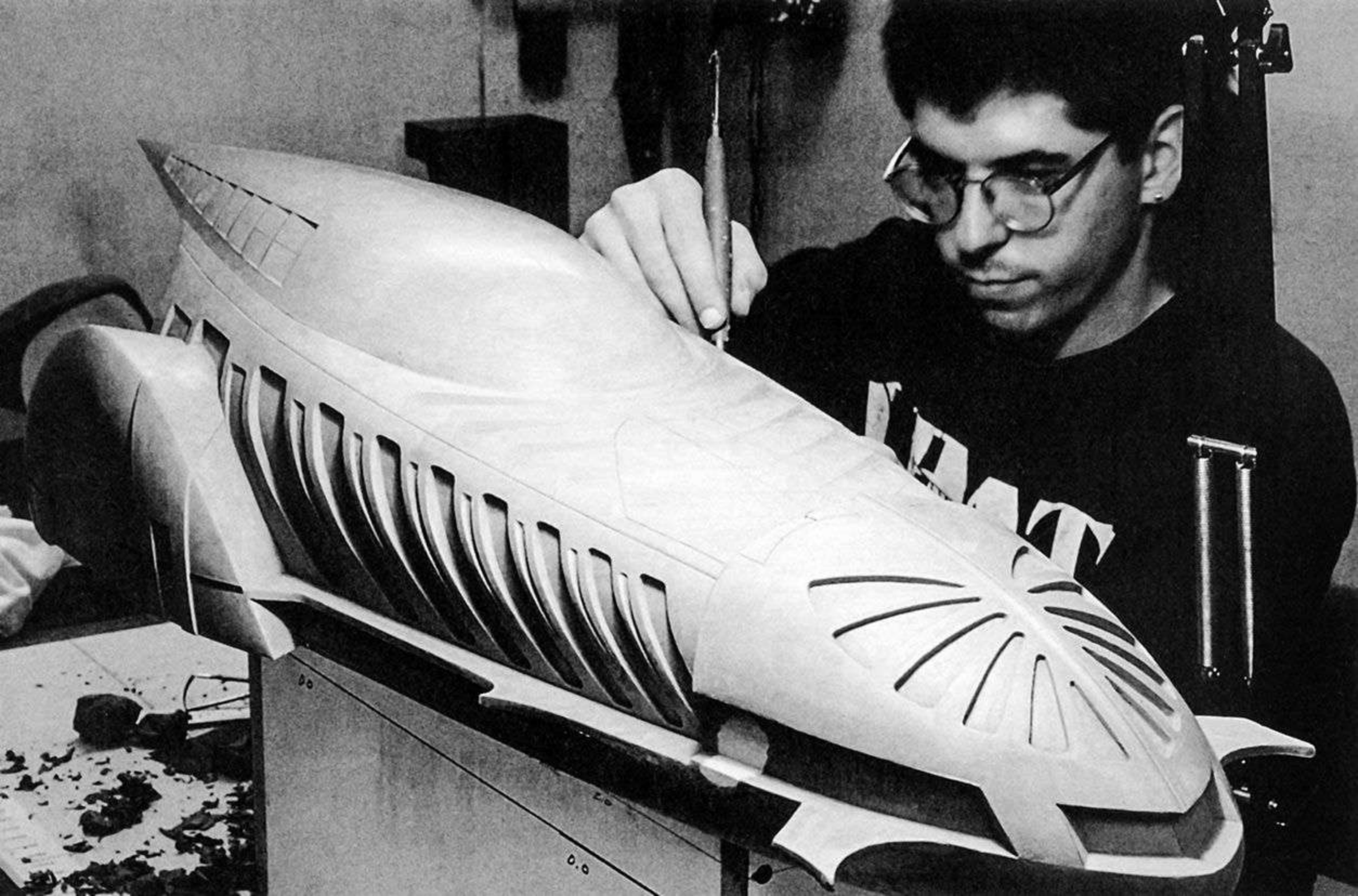
would make it difficult to animate the wings. "I was afraid we wouldn't get realistic motion on the big one," Baker admitted, "because bats are not that big and they flap their wings really fast, with their elbows going in and out in one motion. But the big bat, in many ways, worked better than the little one. We mounted it on a counterweighted parallelogram dolly that could pivot and tip the body as if it were flying. The rig was pushed manually on a motion control dolly track, which made for a smooth ride." Although both bats were filmed, only the smaller one made the final cut.

Also excised from the film was a flock of some three hundred computer generated bats created by MetroLight Studios. Technical director Jim Berney had written special software that allowed fellow tech director Rosa Farre to create a flight of bats that swirled past Bruce Wayne and Alfred during a trip to the batcave's lower levels. The company was also in charge of creating the iconic bat signal which, with some eight shots, would have more prominence than in the previous films. "At MetroLight, we have mastered the more difficult, physical-based effects such as water, smoke, fog and hair," observed supervising producer John Follmer, "which is why we were well suited to do the bat signal. John Dykstra wanted us to take the signal into more of a 3-D realm. We created and comped a beam, the signal itself, and the clouds upon which the signal is projected using our proprietary and commercial software."

In *Batman Returns*, the bat signal had been accomplished in-camera using artwork projected onto fiberfill clouds. With the new generation of digital tools, however, MetroLight would be able to produce an even more dimensional look. The company began with a cloudy daytime sky plate that was digitally processed and combined with computer generated clouds to suggest a night sky scene. With a little digital sleight of hand, lead technical director Tomás Rosenfeldt distorted the cloud picture to provide a rippling effect when emblazoned with the computer generated signal. "We ran a random distorting function throughout the cloud still image to make it seem as if it was rippling, even though it was not moving," Rosenfeldt said. "It was basically a procedural texture-mapping effect to make the beam appear as if it were going through cloud mass. And since one cloud layer looked too flat, we created ten layers to give the impression of depth, then projected the signal onto those layers."

Later in the film, the Riddler would mock the bat signal by projecting his own signature question mark onto the Gotham skies. The question mark signal and subsequent zoom-back revealing all of Gotham beneath it would prove to be one of Illusion Arts' most challenging digital shots. Digital supervisor Richard Patterson and matte artist Fumi Mashimo studied the dispersion of a laser beam in milky water as a guide to simulating the scattering of the Riddler's green laser in the clouds. Mashimo then used Form Z and Electric Image software to create an invisible 3-D conical projection of the question mark. Where the projection intersected the moving cloud geometry,



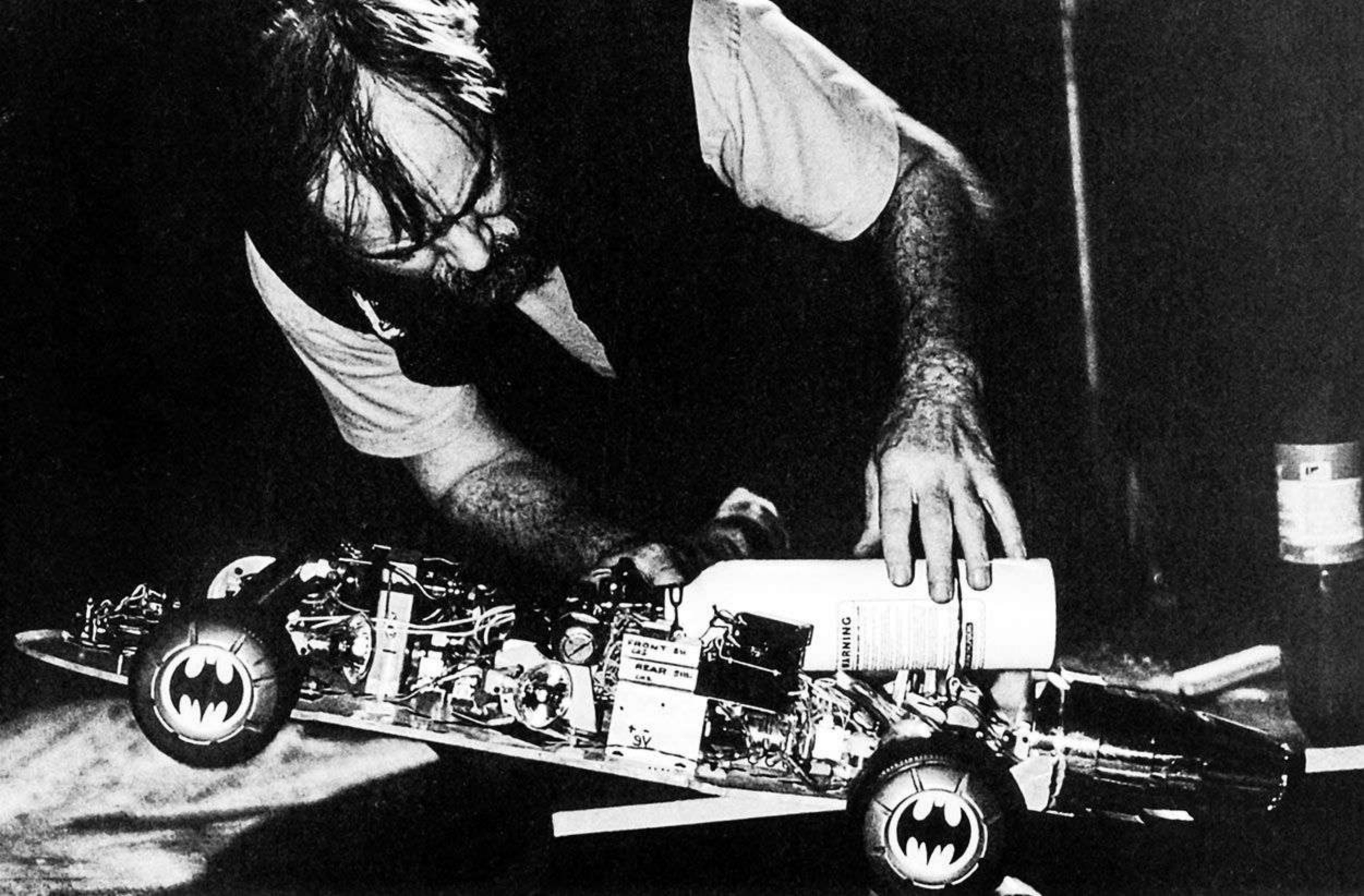


it formed the outline. Diffused and hard outlines were wiped on with animation, following the edges of the cone. The 'scatter' element within the clouds wiped on with separate layers of soft-edged animation, and a scanning effect wrapped progressively around the cone as the question mark grew. Serving as the 'period' to the question mark was the bat signal. "Working from MetroLight's established look and image data saved us a great deal of time," explained Illusion Arts co-supervisor Bill Taylor. "It left us freer to develop the pull-back and laser animation." Patterson, Mashimo and composite technician David Williams combined dozens of 3-D and 2-D elements with the master Gotham matte painting to create the final zoom.

Once alerted to the distress signal, the Caped Crusader had his choice of land, sea or air conveyance to transport him from the batcave to the city. The famed batmobile was dramatically redesigned for the third film, with the streamlined body combining a ribbed look emulating both art deco lines and an H.R. Giger-style bone structure, set off with sleek wings down the canopy and on each rear fender. The job of building the twenty-eight-foot supercar went to TFX, a new company specializing in motion picture vehicle design and construction. The firm had won the assignment with a sixth-scale display model that was ultimately digitized and transformed into a three-dimensional blueprint used in fabricating the fiberglass body. Scaling down the same data, TFX also constructed a miniature batmobile that was used for several key scenes—most notably one in which Batman drives the vehicle up the side of a building to escape Two-Face and his gang.

In addition to the new design, the production wanted the batmobile to have more engine firepower than its previous incarnations. "We had a solid aluminum burner in the model car," said Charley Zurian, a partner in the company with previous experience designing and building GM automobiles, "and by remote control we could open the valves and fire it up. The big car also had a burner powered by two twenty-five-gallon propane tanks. At maximum power it could shoot out a flame twenty-five feet and produce searing heat up to a hundred feet away. The flame was so hot that when we were testing it in our shop—which is twenty-five thousand square feet and twenty-five feet from floor to ceiling—it set off the sprinkler system." To impart a more dramatic look, an internal mechanism manually controlled by the driver sprayed red 'fog juice' into the spewing flame. "The miniature used propane shot with strontium nitrate for a much brighter flame."

The batwing, featured in the film's climax, was one of the key pieces of miniature photography overseen by Boyd Shermis who—like Eric Durst and his crew—spent months working out of the old Hughes Aircraft hangar. For the batwing shots, Grant McCune Design produced a twelfth-scale model which was attached to a motion control mount. Twenty-fourth-scale tunnel miniatures, also built by the McCune team, were used for background plates into which the craft would be composited for its flight from the batcave to the surface world. "The original bid


BURNING

called for a tunnel carved out of rock," McCune recalled, "but Barbara Ling and James Hegedus later changed it to be more like Carlsbad Caverns. We made sixty feet of tunnel out of the usual chicken wire, wood, tin foil and shot foam. We built about five different sections so they could be rearranged, with the longest section about twenty feet long and the shortest about twelve. The sections averaged two to six feet in diameter, since the bat tunnel was supposed to go from large to small, making for a very scary ride."

The horizontal bat tunnel sections were designed with openings to facilitate filming by a motion control camera moving on a parallel track. The geological aspect of the tunnel would figure in Shermis' flight choreography. "John Dykstra wanted to do something sleeker than the traditional gliding moves you make when you're out in space," Shermis explained, "with the batwing maneuvering like an F-16 fighter. John gave me the basic direction, but left it wide open to my interpretation. We shot all the tunnels first and then had to put the batwing into that environment. We had shot video of the tunnel camera moves, which we used as a background to line up the flight path for the foreground batwing element, plotting and mapping out the flight on the fly. Although the programs were generally light-years apart, there were some shots in which we could use the same motion control data, particularly if there was a banking move in which the batwing had to do a counter-roll during its flight through the tunnel." Rather than using bluescreen or greenscreen for the model photography, Shermis opted for orange phosphor screens which he determined would allow for better matte extraction in the digital environment.

Compositing the batwing and tunnel elements fell to Composite Image Systems. The company, which had a longstanding professional relationship with Dykstra from the Apogee era, had a core team of fifteen digital artists concentrating on nine sequences and ninety-nine shots for the movie. The four-cut batwing launch sequence alone required CIS digital compositing supervisor Don Lee to combine twenty-seven passes ranging from batcave and batwing beauty passes to lighting, smoke and engine glow passes. "We've created our own software and hardware system that allows anyone to interact and quickly evolve an image in low-resolution that we can then replicate in high-resolution," explained executive producer Joe Matza, a company co-owner with Rob King. "We also use Flame or other systems where appropriate. In the case of the launch, Boyd took the high-rez footage, got on the Flame with our Joni Jacobson and, with the light pass edges from the 2K image, painted it on the batwing to add a subtle contact light. Many of our shots involved such detailing."

The Caped Crusader's entire arsenal of vehicles, tools and weapons would be employed as he battled both the Riddler and Two-Face. Fans who had never cracked a Batman comic book were already likely familiar with the Riddler from actor Frank Gorshin's turn in the old TV series. Two-Face, however, had failed to grace the show during the three seasons it was on the air. But for fans of the comics, Two-Face not only belonged on the 'A' list of bat-foes, he literally embodied the dualistic tone of the Dark Knight's world. Two-Face had been designed by Batman creator Bob Kane as a conceptual variation on Dr. Jekyll and Mr. Hyde. A tragic figure, he had once been the handsome Harvey Kent, a crusading Gotham district attorney, until acid thrown at him by a gangster disfigured half his face and unhinged his mind. (The character's name inexplicably changed to Dent later in the series, possibly the result of a typographical error.) Two-Face's modus operandi entailed crimes revolving around the numeral two, with a caper initiated by the flip of a silver dollar. If the scarred side of the coin came up, law-breaking anarchy would be in store; but if the clean side surfaced, Dent's law-abiding instincts would prevail.

For his role as Two-Face, actor Tommy Lee Jones would have his features bisected by makeup—the right side of his face left intact and the left side rendered a monstrous mass of ruined tissue. The job was a natural for Rick Baker, whose career had been inspired by the classic Universal horror makeups of Jack Pierce. Using the computer as a design tool, Baker began the creative process by scanning in photos of Jones and working out a range of Two-Face visages. "If it weren't for Photoshop, I probably wouldn't have designed the particular makeup I did for Tommy Lee," Baker observed. "You can do things with a computer you just can't do with rubber. On a computer you can do a painting various ways, change things and save it. It frees you up to be a lot bolder in the design phase."

As with all effects work based on two-dimensional drawings, the challenge was to create a makeup that was true to its comic book origins but could still work in three dimensions with a real actor. "The Two-Face stuff in the comic books had this big eye and a whole bunch of teeth exposed," Baker recalled, "and to create that would have required an external prosthetic on the face and rubber teeth, which can really limit the acting. I had wanted to use a contact lens and pull down the skin under his eye, but Tommy Lee wouldn't go for it—the actor has a lot to do with how the makeup evolves. I did the first makeup tests in bizarre colors such as hot pinks and a lot of iridescent powders—something like twenty different colors. Since it was based on a comic book, I didn't want to make it look too real. It was intentionally glossy and atomic-looking—a really insane look."

The division between Two-Face's normal and scarred sides, which Baker had originally conceived as a gradual blend, was also revised to reflect the director's idea of a straight-line split. "I originally had it shaded like a step in the skin, with the burned side raised," Baker explained, "but I eventually eliminated that. The skin was split down the middle with magenta on the scarred side and normal corrective makeup on the other side. And since Tommy Lee would be playing Two-Face for at least fifty days of filming, we eliminated a lot of steps that would have added to the application time without making much of a difference in the final look."

The batmobile—altered from previous incarnations to include a more streamlined body, with sleek wings running down the canopy and rear fenders—was built full-scale and as a miniature by TFX. To promote the illusion of intense engine firepower, both miniature and life-size versions of the car were equipped with propane burners for spewing flame as the batmobile fires up to maximum power. Modelmaker Paul Ozzimo sculpts the body of a sixth-scale miniature used in several key scenes. / Crew member David Beasley adds fuel to the model flame-car in preparation for a shot of the vehicle doing a wheelie down an alleyway.

Working with Baker was Ve Neill, who would apply the foam latex makeup during production, and Yolanda Toussieng, who handled the two-toned wigs. "The scarred-side appliance was five to six pieces," Baker said. "During the test, we applied the initial piece that covered Tommy Lee's head and part of his forehead and his ear, which I stuck flat. The problem was that if anything was off-kilter, the other pieces would not line up correctly; so I made vacuform stencils to glue on Tommy Lee to mark the exact placement of the pieces. The first major piece would go on, followed by a brow piece, then a little piece under the eye, a major cheek piece and a piece for the upper and lower lip. It was like putting together a jigsaw puzzle."

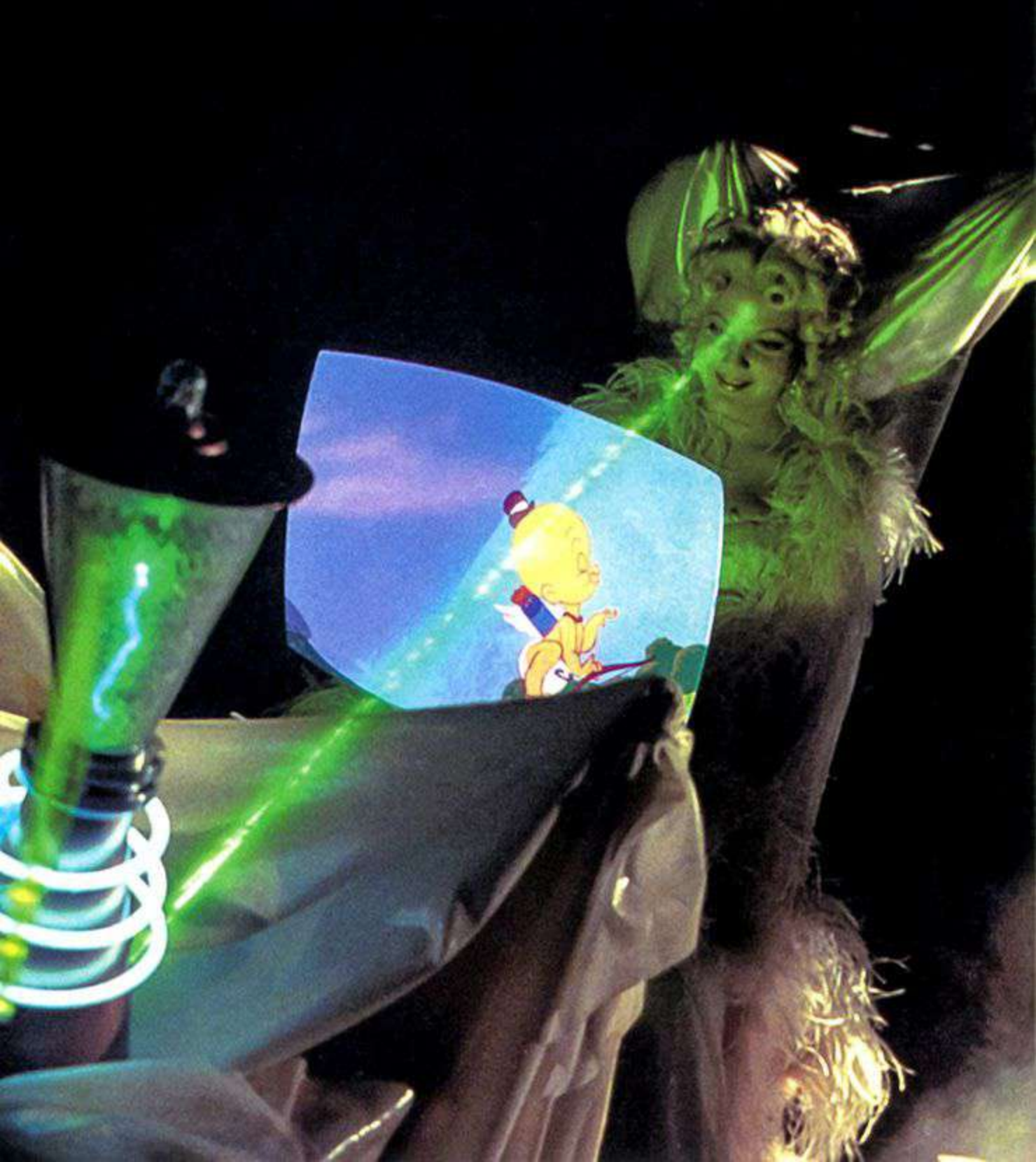
It would be a Two-Face crime that would finally usher Robin into the Batman movie saga. Robin, the Boy Wonder, became part of the comic book series in 1940, after a year of solo crime fighting on the part of the Dark Knight. In the comics origin, Dick Grayson, who with his parents formed a high-flying circus trapeze act, had been orphaned when his parents fell to their deaths during a performance. When it was revealed that gangsters had treated the ropes with acid as part of a terrorist shakedown of the big-top operation, sympathetic Batman took the youth under his wing as a crimefighting sidekick—and the Dynamic Duo soon brought the criminals to justice.

Since the first Tim Burton film, scriptwriters had attempted to write Robin into the big-screen proceedings. For *Batman*, screenwriter Sam Hamm had recounted Robin's origin with a wild, third-act scene of Batman, on horseback, pursuing the Joker through Gotham Park even as the criminal's van crashes into an outdoor circus, bringing down the high-wire platform and killing Dick Grayson's aerialist parents. The scene was discarded, along with the Boy Wonder, early in the production. Subsequent Robin rumors had suggested that the famed character would be introduced in *Batman Returns* as either a black youth or a young girl. Neither proved true.

With twenty-five-year-old Chris O'Donnell cast in the role in *Batman Forever*, it was clear the production was going for a Robin with attitude—more a younger partner than the boyish sidekick of the comics and TV show. The circus milieu of the character's comics origins would be approximated, however, with a sequence at the Gotham Hippodrome. The grand set was erected on a Warner Brothers soundstage with six thirty-foot statues supporting a black-and-white silk tent, sixty feet tall and eighty feet in diameter, covering five hundred seats and a full trapeze rig. An ultra-wide 5mm lens developed by Panavision was employed to shoot the Hippodrome set—as well as a climactic scene at the Riddler's hideout—taking in the whole environment in one shot without any fish-eye effect.

As Two-Face invades the circus, with Dick Grayson scrambling to the Hippodrome roof to dispose of a massive bomb, the production shifted from the soundstage set to a combination of bluescreen elements and Illusion Arts matte paintings. "The production wanted a magical look for the Hippodrome, which we felt we could better create with oils than the more hard-

Pursued by Two-Face and his cohorts, Batman escapes by deploying a grappling hook and cable and driving his batmobile straight up the side of a building. The shot was accomplished in miniature using the TFX sixth-scale vehicle on a like-scaled alleyway set built by Grant McCune Design. / A rooftop POV of the Dark Knight leaping to a bridge far below featured a digital matte painting rendered in exaggerated perspective by Bob Scifo of WBIT. A digital Batman and cape, along with fog and smoke effects, were then composited into the background plate by PDI. / At Two-Face's hideaway, girlfriend Sugar (Drew Barrymore) experiences the Riddler's latest device for stealing cerebral energy. Computer generated beams, consisting of a core of animated particles, were created by CIS and tracked into the live-action shot, along with a floating TV screen which was color-balanced digitally. / The Riddler treats Two-Face to a jolt of stolen brain energy.



HIPPODROME
GOTHAM CHARITY CIRCUS

edged look you get with a computer," said Syd Dutton. "Although we did a traditional matte painting for the master shot, we still took a photograph of it, digitized it, and had Mike Wassel digitally enhance it and add some layers of smoke elements that John Dykstra had sent us."

On the master shot of the Hippodrome, a camera push-in was accomplished with some traditional, low-tech matte painting tricks. The illusion of a perspective shift was achieved with foreground elements of two-foot male figure sculptures on movers and a latent image effect on a single painting of the Hippodrome and the river and city beyond. "We divided the painting plane into two separate elements with an in-camera split-screen," Bill Taylor explained, "so the camera move on the Hippodrome foreground would move at a faster rate in relation to the background view."

"Another simple, but effective, painting had a bluescreen element of the Hippodrome rooftop with Two-Face's bomb rolling down the roof to an extreme down-shot of the harbor and water," Dutton added. "We had a water plate, but we didn't think it worked very well; so we came up with the idea of doing part of the roof, the dock, and the water all as a matte painting, with the bomb element optically composited. To create reflections on the painted water, Lynn Ledgerwood used two sheets of glass, with a resin rippling through the surface, that Mark Sawicki shot separately on a fixed matte camera. That photography was then combined with the water in-camera as another split-screen matte."

Like Two-Face, the Riddler would prove to be both diabolic and criminally unhinged. In the film, the character—played by Jim Carrey—is first introduced as Wayne Enterprises employee Edward Nygma, a brilliant techno-nerd who worships Bruce Wayne from afar. Ignored and rejected, Nygma takes his revenge in the form of a little invention he has cooked up: a TV adapter box that transforms an ordinary televised picture into a 3-D hologram that floats free from the set. Unbeknownst to captivated viewers, the device is actually stealing their cerebral energy and transmitting it to a collector at the Riddler's hideout on Claw Island, where the villain hooks himself up to the incoming, brain-expanding energy.

Nygma's initial test victim, a Wayne Enterprises plant manager named Fred Stickley, is subdued and forced to wear a prototype headset. With a television clicked on to a sport fishing show, Stickley stares entranced as fish and fisherman seemingly emerge from the set and the brain-sapping begins. "Visually, the TV images have a synthetic quality, with color shifts," explained Joe Matza, whose Composite Image Systems assembled the thirty-seven cuts in the sequence. "They're not quite the same resolution as the surrounding scene." To create Stickley's fishy vision, CIS was supplied with footage to treat and matte into the blank TV screen on the live-action plate. For the transition of the fish swimming out of the set, a fish-filled water tank was photographed in front of a bluescreen which allowed the effects company to extract the fish and matte them in space.

The Flame system was used to create color shifts and other surface treatments on the fish, linking them to the video environment from which they had emerged.

"The fish were always a constant element in the design," Matza explained, "but the look of the shots went through several iterations. John Dykstra's original idea was for the fish to have a green, phosphorescent surface glow. Later that was changed to the final look of them shifting color as if the signal beam was breaking up. Another change was the fisherman casting his line, which originally was going to zoom out of the screen. Instead, Andrew Mumford, one of our digital compositing editors, used Flame to take the original photography and create a streak image that was broken up. What made the shots challenging is that we see the television, the beams, and the actors, with Jim Carrey often behind what comes out of the TV. We had to use digital rotoscope techniques for that."

To meet the Riddler/Two-Face challenge, Val Kilmer's Batman would be a more action-oriented figure than he was in the Burton films. There were, however, several Dark Knight action scenes too dangerous for even a seasoned stunt performer to attempt, including a six-hundred-foot fall from the roof of a Gotham hotel and another jump from a rooftop to a bridge. Both a digital super-stuntman and a CG cape would be created for the scenes. "Everything in the picture was done to achieve a particular stylization," Dykstra commented. "The Batman and cape of the comic books and graphic novels have characteristics different from what a real person or a real cape would have; and we wanted to recreate that stylized sense of movement. For the six-hundred-foot fall, our CGI superhero allowed us to give the character the graphic quality of the comics by controlling the cape and its relationship to the character, something you could never do with a real stunt person."

Batman's fall from the rooftop of the Ritz Gotham, with the hero deploying his cape like a parachute for a safe landing, would not only feature a digital Dark Knight, but another computer generated city environment from WBIT. Dykstra's design for the fall—a continuous shot with a camera move following the plummeting Crusader, then accelerating past and whipping underneath him—would have been an almost impossible feat for even the most imaginative director of photography. "During the scene," said Dykstra, "we go with Batman as he falls and deploys his cape. The look is like that of a skydiving camera—not something you would want to attempt in a practical sense. But with computers, you now can have an invisible camera that doesn't need to be attached to anything and that can go anywhere, even through walls." The breakthrough CG hero utilized motion capture of a performing gymnast recorded by Acclaim Motion Studios. "We set out to do motion capture for our animated figures at a time when motion capture was, at best, a relatively unsophisticated technique. But we had the good fortune to work with people at Acclaim who had developed a prototype system that provided us with the high-resolution data we were able to use as the template for animating our figure."

Before a vendor was selected to create the CG superhero, a number of effects houses were encouraged to compete for the assignment. Each company was supplied with the motion capture data, a WBIT background city and the same camera moves. Pacific Data Images was finally awarded the job after producing a continuous shot of their computer generated Batman landing softly as the cape arrests his fall, then walking away with a roll of the neck and a shrug of the shoulders. The rough test was so effective that it was cut into the theatrical trailer, although the look of the shot would be changed appreciably for the final film. "One of the first digital stuntmen was the lawyer that gets eaten by the T-rex in *Jurassic Park*," stated Richard Chuang. "This was the next logical level."

Heading up work on the digital Dark Knight was technical supervisor Dick Walsh and animation supervisor Raman Hui. "Creating a character that's basically a black rubber suit at night was perfect for the current capabilities of digital technology," Walsh observed. "Dykstra arranged for Viewpoint DataLabs to scan and digitize a sculpture which we then took and modified to work with the Acclaim motion capture data. I was also provided with a low-rez version of WBIT's in-progress cityscape forms that would go behind our falling character. To me, one of the most amazing aspects of the work was the way our proprietary system could take the motion capture data, our own animation, and use a parallel animation system to blend the two."

Another CG Batman shot—a rooftop POV as Chase Meridian watches the Dark Knight leap to a bridge far below—was designed to look exactly like a comics panel, with a shadow of the figure appearing as a graphic bat silhouette image on an adjoining building. The shot, with its exaggerated perspective of the nighttime cityscape, would be accomplished as a WBIT 3-D matte painting. "Because there was going to be a CGI Batman, we figured it would be better to create our element in 3-D," said WBIT art director Bob Scifo. "It really went beyond the parameters of a painting because it was created from a 3-D model within the computer." Scifo, who had come out of a traditional matte painting background, utilized StrataSTUDIO Pro on a Macintosh. "Instead of a brush and oils, you draw with a cursor or an icon that looks like a brush. From my matte painting experience, I learned how to give impressions of things, the mood and essence rather than every brick on a wall, which also helps when creating images in the computer. For Chase's POV, I set up the cameras, then shot 3-D wire-frame with textures applied to the surfaces and reflections. In the street below, I put animated headlights. As a matte painter, you always try to get action and motion into a shot, to create a feeling of space and avoid making it look two-dimensional. On this shot, I was able to touch up the image just as I would with a painting; but then I could add movement to it by burning in a three-dimensional headlight moving across a building."

Toward the climax of the film, Two-Face and Riddler team up at the Claw Island lair. The concept for the island—created

Matte artist Syd Dutton and cameraman Mark Sawicki of Illusion Arts prepare to shoot one of the matte paintings created for the film. The scene—an establishing shot of the Gotham Hippodrome where Batman first encounters Robin performing in a circus act—was enhanced by three-dimensional miniature statuary positioned in the foreground for added depth. / Modelmaker Smokey Stover of Grant McCune Design completes work on a sixth-scale batwing used in a climactic battle scene. Built by Stover and Edward Lawton, the versatile plane was rigged to jettison its wings and convert conveniently into a batsub upon submerging in water.

A twelfth-scale batwing hangs on a miniature section of the batcave wall. / For an establishing shot of the Riddler's Claw Island lair, a miniature set was built and filmed motion control. Digital artists at CIS enhanced and composited the multiple passes required for the shot, combining elements such as lights, foreground and background smoke, layered laser effects and a synthetic sky. / With his cape deployed like a parachute, Batman plummets six hundred feet in a breathtaking dive from the rooftop of a Gotham hotel. PDI accomplished the action digitally with a computer generated superhero and cape animated utilizing high-resolution motion capture data from a performing gymnast. The computer generated stuntman was then composited into free-fall background footage created digitally by WBIT.

both as a miniature and as a full-size soundstage set—was of an abandoned helium distillery with hundred-foot-tall glass globes, one of which was the throne room where the Riddler received the collected brain energy streaming in from Gotham.

The Claw Island model was ten feet tall, with a welded steel structure representing four columns of the old plant and a motion controlled pyrex glass cone for the brainwave collector. Throughout were some nine hundred tiny tungsten lights and dozens of moving spotlights. The jangling action of the incoming energy captured by the collector was realized as a laser effect. "We came around to the idea of employing lasers for the effect," explained Boyd Shermis, whose team was in charge of the Claw Island shots, "but we modified the technique with a little experimentation. Essentially, we took lasers and bounced them around into a cylinder of crumpled mylar placed on a motion control rotator. By defracting the beam, we got different colors and swirling patterns of laser light bouncing around inside the cylinder. We could then project those patterns onto the surface of the cone collector itself."

For the digital compositing artists at CIS, the establishing shots of Claw Island were a complex combination of miniature island beauty pass, lighting passes, matte pass, CG beams and other elements. "For the sky, we used multiplane techniques, developed by Andrew, which entailed taking some still photographs of clouds, scanning them at very high resolution, and putting some perspective manipulations and camera moves on them," Joe Matza explained. "Then we would take another layer of clouds and move the cloud elements against each other. On top of all that, we laid in electrical discharges and the light and smoke passes."

Claw Island was the setting for the end game, with Chase Meridian in the clutches of the villainous pair. To the rescue come the Dynamic Duo, with Batman arriving by batwing and Robin by speeding batboat. The Riddler has prepared for such an eventuality, of course, by stringing underwater mines to take out the batboat, leaving Robin floundering, while a deadly ray severs a wing from Batman's plane, causing the aircraft to hit the water. Ever prepared, Batman pulls a lever, ejecting the wing attachments and converting the plane into a submarine.

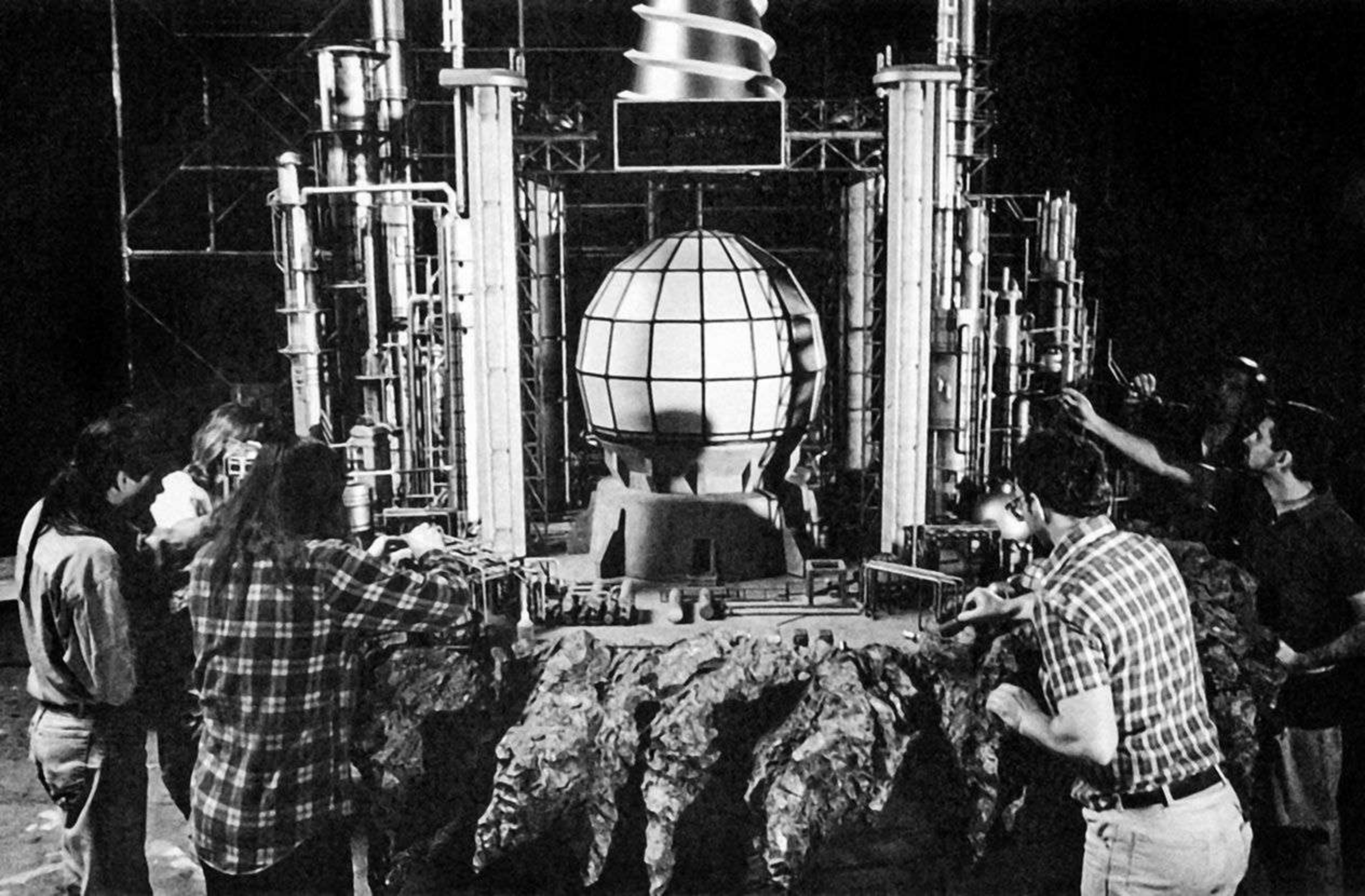
Both the mine explosions and the batwing crash and sub sequence were staged by Greg McMurry and the VIFX effects crew. For the underwater blasts, pyro was rigged in the facility's six-foot-deep outdoor water tank and shot at 200 frames per second. Pyro effects, by Richard Helmer, were time consuming and required meticulous preparation. "Everything you do underwater takes forever," McMurry commented. "The most difficult thing about doing pyro underwater, of course, is that everything gets wet; so you have only a limited amount of time to get your shot once everything has been rigged. If you wait too long, nothing will happen when you set it off because the pyro will have been saturated with water."

Fifteen mines of varying sizes were built and submerged in the tank to simulate a minefield in forced perspective. "The largest mine, the one that was actually loaded with pyro, was about twelve inches in diameter. The smallest was about three inches. Inside each mine was the Riddler's signature question mark, which was electronically lit." The mines were built into a grid in the concrete block tank, then photographed through a four-foot glass port. "We could line up the whole minefield and get just the perspective we wanted so that it looked as if it was going off forever." On one take, in an attempt to create the ultimate underwater explosion, the effects crew overdid it and blew out the glass viewing port. "We were trying to push the envelope with bigger and bigger explosions—but we pushed too far. That was a bit of a set-back, but we got it back together within a day and were shooting again."

The ensuing batwing crash and sub sequence involved approximately ten shots filmed during a two-week period at the Los Angeles Swim Stadium, with inserts achieved at the VIFX water tank. At the Olympic-size pool, a sixth-scale batwing model built by Grant McCune was photographed high-speed—at 60 frames per second—by the VIFX team. For the approach and crash, the model was mounted on a track rig—driven by a system of belts and cables—which was positioned ten feet above the pool. The impact was filmed from an underwater vantage point. Once the batwing was submerged, it was switched to an underwater track rig for further movement. "Pete Romano was our underwater cameraman," McMurry related, "and he used his own HydroFlex camera housings for the work. Once the model was in the water, we rigged it so that the wings would jettison and it would become the bat-sub. Each one of the wings blew off separately, which we did with pyro effects."

Both the pool and tank were treated with green food coloring and milk to make the water cloudy and give it appropriate visual density. "The pool filter was really efficient," McMurry recalled. "It kept filtering out the food coloring and milk, so we were constantly having to add more to keep up with that." Bubbles were added through bubble wands positioned around the tanks to give the shots a greater sense of activity. The underwater sequence was also enhanced with searchlights, replicating those emanating from Claw Island in the live-action shots. "We used xenon searchlights which we had hanging from overhead. We had to time the light beams moving through the water just perfectly so that they would illuminate whatever action we wanted to capture on film. The lighting scheme for the scene was such that the water was perfectly dark except when it was hit by a searchlight; so we had to have searchlights pass over the area we wanted to see at just the right moment for each event." Insert shots—including closeups of the wings separating—were filmed at the smaller VIFX tank. Nearly all of the completed shots required digital wire removal since it was impossible to shoot the underwater footage without rigs and track showing up in frame.

To save Robin, who has been grappling underwater with some villainous assailants, Batman launches himself through one of the sub's missile tubes. "We propelled a Batman puppet



on wires for that shot," McMurry explained. "The initial launch was done with compressed nitrogen. There was a tube of nitrogen gas inside the sub which was operated by remote control. As the sub came towards camera and got into the position we wanted, we would launch the puppet with a trail of bubbles streaming out from behind him. The trouble was that, unless something is shaped aerodynamically like a torpedo, anything you propel through water is going to veer off in all directions. So the puppet had to be mounted to a wire in order to make it travel in exactly the direction we wanted. That wire was then digitally removed."

Swimming to the surface, Batman and Robin see Claw Island being lifted into the air by a massive hydraulic cylinder. "We didn't physically move the model," Boyd Shermis said. "We just put it on a twelve-foot cylinder and moved the camera to create the illusion that it was rising."

Separated from his young protégé, Batman makes his way into the Riddler's lair, where he finds both Robin and Chase imprisoned in cages poised over the hollow cylinder. The Riddler releases them, causing the two to fall into the cylinder toward certain death on the rocks and crashing surf below. Batman dives after them, catching both and securing them with cables. The shot, with another skydiving camera move, was created with the principal actors filmed bluescreen and composited into a CG background provided by Rhythm & Hues. "We had to composite the 2-D plates of the characters into a 3-D world, and supply scale and speed inside the cylinder," explained Rhythm & Hues effects producer Teresa Cheng. "There was a lot of R&D for the look of the tunnel—which we modeled from blueprints supplied by the production—and much creative judgment as to textures, colors and lighting. The most important thing was the rate of speed for the fall; but since the scene was cut like a music video, we had to work on the apparent speed and scale, not the actual physics. The shot was an illusion, so it just had to look right."

"It was an illusion of speed," added Kathy White, effects supervisor on the sequence. "We were in a CG world, falling down this tunnel, so the camera speed and the tunnel length needed to be believable. But in real life, the acceleration rate is something like thirty-two feet per second per second, which would have had us hitting the ground in the first shot. So we did a cheat, with the walls and bottom as separate elements, each coming up at a different rate of speed relative to each other. The perilous sense of freefall was achieved by dropping our camera down the tunnel very fast. Continuity from shot to shot was maintained by allowing the bottom of the tunnel to move away from the camera at some percentage of the camera speed. We also used motion blur, textures and detailing to add realism to the shaft." The cylinder's steel surface, cut through with Riddler question marks emitting shafts of light, also helped Rhythm & Hues impart a dangerous sense of speed and scale, with lights and shadows interacting with the live-action characters pulled from bluescreen and integrated into the digital environment.

Batman saves the day and, with Two-Face having taken a seemingly fatal fall and the Riddler reduced to babbling incoherence in a padded cell at the Arkham Asylum—another Grant McCune miniature—Gotham City has once again been given a respite from crime. As the latest chapter in an ongoing series, *Batman Forever* achieved a stylistic look emblematic of comic book graphics. The classic production tools—motion control miniatures, matte paintings, bluescreen, huge soundstage sets, location work—had been needed to meet the creative demands of the production. The adroit use of computer generated performers, the construction of a completely synthetic cityscape, the digital layering of elements and image processing flourishes also helped bend the images into comic book compositions.

For John Dykstra, who had come of age during an era of physical materials and photochemical processes, the new digital tools would forever alter the creative dynamics of filmmaking. "Breakthroughs are sort of commonplace these days," Dykstra reflected. "The sky's the limit now. But this embarrassment of riches puts you in the position of having to embrace change constantly. When you set out to do a picture that will require a year to finish, you have to recognize that ideas you are unable to execute at the beginning, because of limitations in computer imaging technology, may well become practical by the end of the picture. So now you have to anticipate. Delving into what computers can do is sort of like opening Pandora's Box. In fact, I don't think anyone really knows what the limits of computers are, because right now there's somebody someplace who's working to overcome one of the currently accepted constraints."

Joel Schumacher shared his effects supervisor's appreciation of the new visual effects tools now available—particularly since those tools made it possible for him to complete his movie on a compacted schedule. "We were all scared at times because the production deadline seemed to be coming at us like a speeding train," Schumacher admitted. "But we made it; and everybody who worked on the film deserves an enormous amount of credit—none more so than the visual effects department. Amazingly, we did not lose a single effects shot—not one planned shot was dropped from the movie because of deadline pressures. I can't think of an adjective big enough to describe what John Dykstra did in organizing that effort."

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Modelmakers add finishing touches to the ten-foot-tall Claw Island lair, setting for a climactic confrontation between Batman and his nemeses. The miniature set included welded steel columns representing an abandoned factory and a giant brain wave collector fashioned from a pyrex glass cone. Incoming energy waves captured by the collector would be realized through digitally enhanced laser effects designed and shot by Boyd Shermis and his team, then composited by CIS. / Engineered at MetroLight Studios, the bat signal was given a dimensional look by distorting the digital cloud image onto which the computer generated signal was projected to create a slight rippling effect. Lead technical director Tomás Rosenfeldt, technical supervisor Jerry Weil and supervising producer John Follmer survey the results. / A miniature constructed by Grant McCune Design was used for an establishing shot of the Arkham Asylum, where the Riddler is at last fittingly consigned.

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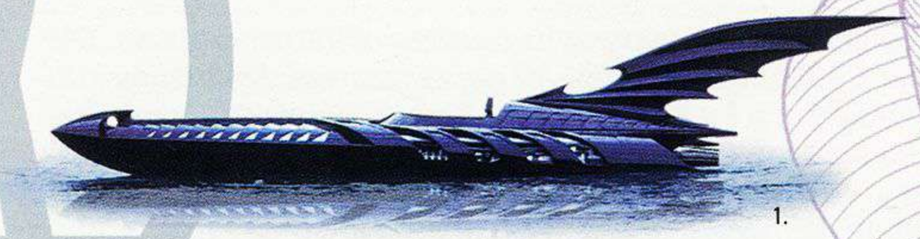

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The TFX team would like to thank Warner Bros., Joel Schumacher, Peter MacGregor-Scott, Barbara Ling and John Dykstra for the opportunity to contribute to *Batman Forever*.

1.Batboat™ co-fabricated with Joel Shepherd and VIP Marine. Batman and all related elements are property of DC Comics, ™ and © 1995